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THE OPPORTUNITY OF THE ENDOWED UNIVERSITY

AT first glance there would seem to be opportunity, in this country, for more than one type of college and university, and if the opportunity, then the obligation and the inspiration. Historically there are two types, but under identical environmental influences they present to-day few distinguishing characters. They exhibit a phenomenon very rare and interesting in biology. While we have been speculating and searching about the origin of species by evolution, the history of the American colleges has recorded the almost complete disappearance of a species through imitation, a transmutation instead of a mutation! The endowed college, later called university, was the first type to appear on the American continent; but with the growth of the public school idea, with the outgrowth of those aristocratic remnants which the early settlers so unconsciously brought with them and so strongly exhibited, and with the immense addition to the English stock by immigration from continental Europe with its universities founded and maintained by the funds of the people, it was only natural that state universities should come into existence. For the most part they are found in those states which have nothing more tangible to connect them with the past than *traditions* of aristocracy, and at all events they prosper most, if one may judge by our usual American standards of dollars or of numbers, in the states in which the people is most thoroughly satisfied that the people can do no wrong. The future, the opportunity, of the endowed university may appear, therefore, to

be anything but bright and inspiring; but an honest examination of the circumstances of the state and the endowed universities will lead any one to rejoice in the prospects of both.

The state university is endowed with the wealth of the state; its endowment increases with the wealth of the state, automatically and without struggle. What this has already meant in certain instances is but a small fraction of what the future has in store. The wealth of the richest of the colleges of Oxford and Cambridge is poverty in comparison with the potential wealth of some of our state universities: unless and until the descendants of the people which called the university into being recall it to a condition of penury. The endowments of the state universities yield incomes the large totals of which are increased at intervals by appropriations for such specific purposes as have won popular or legislative appreciation and approval or may capture the fancy of the self-styled "practical man."

The contrast of the endowed university with all of this seeming prosperity would be disheartening to its friends if they took no account of the influence of the endowment and income. While the income of the state university may grow proportionally with its endowment, its officers and friends take nothing for granted and occupy themselves in securing this happy result. On the other hand, once sufficiently endowed to be useful, the endowed university need not struggle for money. It will never have too much if it wisely spend what it has; and if it transmutes its gold into lives of exceptional usefulness, more gold will come to it from grateful alumni and from admiring friends who would increase its opportunities for service. The endowed universities have struggled for money as desperately as those of the states, but this has been either because they were insufficiently endowed or because their administrations, not content with usefulness, lusted after bigness also. But given a sufficient endowment, so managed that its income will be both fair and uniform, the endowed university is independent as no state university ever is: not free from duties, but free from hindrances.

What the people wants, what it pays for, it rightly insists upon having. The people goes further and says that these things all the citizens of the state should have. The people insists above all upon training for practical life. To the schools of law and of medicine, agriculture and engineering, it enthusiastically and optimistically adds courses in domestic science, poultry husbandry, cheese-making, and the rest. Has it occurred to the "practical" legislator or the "practical" voter that the establishment of courses in domestic science has been followed by a more acute stage of the servant question? Is this mere coincidence?

The people demands of its university that it be in every way useful, that, where training is impossible, at least it should give information. In response to this demand come university extension (not university elevation), summer schools, farmers' institutes, short courses and correspondence. The young American democracies provide not only a "royal road to learning," but omnibuses traveling rapidly over the road with pneumatic tires—I forbear to mention the temperature of the air which fills them. These omnibuses always take in and discharge their passengers in haste and confusion, sometimes even in darkness. They must be driven by persons capable and sometimes desirous of taking a more promising company over a less commonplace road, whence the views, forward

and perhaps even upward, may be more extended.

As part of the educational system of the state, the state university must admit all presenting a high school diploma. It can not sift, and exclude the ignorant, for there is none ignorant, as the certificates show! It can not insist that the boy who would be an engineer present himself with a usable knowledge of algebra and geometry. It is obliged to accept as a working basis the popular delusion that all subjects furnish equally good preparation for college as well as for everything else, that all study is equally informing and developing, that all students are equally fit. But in so doing, in its seeming liberality in keeping its front door apparently so wide open, it places obstacles in the way of all who would enter from any other than the conventional school. The seriousness of these obstacles is seldom apprehended by others than those who encounter them. The boy whose family has traveled, taking him with them—the son of an engineer, or a missionary of commerce or religion, for example—having attended an accredited school for too short a time to receive a certificate, or being taught in a private school or in still more private lessons quite unknown to a registrar's office, finds himself unable to enter the wide open front door of the usual college, state or endowed. Although very likely more mature and better trained, of wider as well as more definite or first-hand knowledge, of broader experience and more independent thought, he is refused admission unless, by passing examinations to which only he and his kind are subjected, he convinces the authorities that he knows almost as much as a boy from the Bean Blossom High School in Posey County.

The state universities are more or less compelled to take the products of the public schools unsifted; they can not especially cultivate and encourage the exceptional young person; they must do mainly a wholesale business; and they are increasingly burdened with great numbers of conventionally trained mediocrities. They are necessarily organized to receive, care for, graduate and find positions for these. Thus they annually produce more teachers who will produce more students of the same mediocre sort. What this weight of numbers is may be indicated by the attendance, in round numbers, on the usual elementary course in botany at the following universities:

Wisconsin	300
Minnesota	500
Nebraska	350
Stanford	50

Botany I. at Harvard, a fairly large course (130), is not the equivalent of Botany I. at the universities above mentioned, and the corresponding course has between 40 and 50 in it. Granting the stimulation of lecturing to large numbers, what is the effect of attempting laboratory work for so many? Providing, in the winter, plant material for such numbers, organizing and directing the staff of assistants, conferring with students in this and in the more advanced courses, the head of the department and his colleagues find their time, their strength, and finally their desire, for their own researches exhausted. There is no time for reflection; every one is so busy doing that there is no opportunity for thinking; every one is working at high pressure, but is it worth while? Researches come from these laboratories, but they are not original. They are the products of the changing fashions rather than the fruit of individual effort. A glance at the programs of the national scientific societies proves that isotonic coefficients and chromosomes have been displaced by mutation, Mendelism, and plant-breeding. American

universities add annually to the "literature" of science, and in the great numbers of elementary students to be cared for I think we can all see one great reason why the contributions of promising American scientific men have reached no higher level.

Turning now to the endowed university, it is obvious that its officers need spend no time at the capitol, for its income can not there be increased; they need make no concessions in order to keep Greek from disappearing from the catalogue; they can let others wrestle with the problems of "educational psychology," "humanics" and "live stock practise" while devoting themselves to psychology, sociology and zoology. The endowed university may go its own way independent of the currents of fashion and of popular whim. It is naturally sheltered from those influences. It is only when its leaders attempt to duplicate the work of the state university that it finds itself exposed to the same influences. And when it exposes itself to these influences, it does so without the defenses of the state university.

The opportunity of the endowed university is a great one, inspiring to contemplate. It, or its *directing* administration, may determine its course, select the subjects it will teach, specialize instead of generalize, foster pure science and the arts. Whether American universities be democracies or autocracies, all or some of the officers of the endowed universities have the opportunity, and the obligation, to decide what these universities will do—whether to compete on unequal terms of wealth and of other forms of support with the state universities, to seek numbers, to strive for bigness, to submit to the fashion, to comply with the current wish: or to decide what it will attempt, what subjects it will cultivate, to teach and to investigate and to develop these to a degree unequaled elsewhere; to pursue the studies of pure science, the humanities and the arts as assiduously and as devotedly as if they were themselves the keys to wealth.

The endowed universities may select their students on any basis that they will; may pick the children of the well-to-do or young people whose unprogressive parents have cruelly limited them to schooling in Latin, Greek and mathematics when they might have "taken" hygiene, civics and "vocational subjects"; may, on the other hand, welcome the exceptional as well as admitting the usual; may cultivate and encourage the best. The endowed university may as consciously and as definitely prepare for the few, for the unusual, the most original and the most stimulating student as the state university must certainly prepare for unsifted numbers.

The masses of a democracy recognize present wants more surely than they anticipate future needs. They require an immediate supply to meet an existing demand. They consider their state university to be well fulfilling its functions when it furnishes such a supply. How well it succeeds in this the fair-minded observer admiringly acknowledges. But the wholesale business of the state university limits, if it does not practically prevent, that attention to the exceptional student which may result in training a leader of his generation, a seer who, divining the future needs of the state, may begin to prepare to meet them, a man who, profiting by the recorded experience of the past, may mold as well as meet conditions. The training of workers is the duty of the state and of the endowed university; the training of leaders is the privilege more especially of the endowed universities for the reasons I have given. How well some of the endowed universities have apprehended and lived up to this privilege the records of

Harvard and Yale, of Columbia and Princeton, and of Johns Hopkins *sui generis*, fully attest. May they not neglect their privilege and abandon their peculiar work!

What the endowed universities have successfully and naturally done for generations some of the state universities are now attempting against opposition of every sort. How successful, judging only by the test of quality, not of numbers, these universities will be in producing statesmen, jurists, economists and explorers in the fields of pure science, it is still too early to say. To recognize these in embryo, to train these young people for their distinctive careers, is easier for the endowed university than for that of the state, provided only that the endowed university, realizing its privilege and confining its efforts to its special field, does its duty. This, I take it, is the special service which the endowed university can perform, its reason for existence by the side of the university of the state, not copying it, not competing with it, but supplementing it, training leaders.

Their numbers, their courses, limited by their incomes, the endowed universities may remain small with no sense of shame or of failure. The Rookwood Pottery is smaller than many a brick-yard, yet all are needed, all are useful. In the space and quiet of "the yard" or of the quadrangle there is time for reflection, for review, which in the past have led to real contributions to knowledge or to thought. The scholar's life and the scholar's product, not fostered by the conditions of office or consulting-room, may continue if the endowed universities recognize and cherish their high privilege, serving the state and the world with their own peculiar talent, not copying the form or attempting the task of their huge neighbors, not seeing in them rivals but friends. May these allies, realizing their privileges, their distinctive opportunities, win the glories of their recognized usefulnesses!

GEORGE J. PEIRCE
LELAND STANFORD JUNIOR UNIVERSITY

RESEARCH ON THE SMOKE PROBLEM AT THE DEPARTMENT OF INDUSTRIAL RESEARCH OF THE UNIVERSITY OF PITTSBURGH

SMOKE exists to a greater or less extent in every city where soft coal is burned. The world at large has not, up to the past few years, regarded it as a waste. It has been considered synonymous with prosperity. Its right to cloud the heavens has been traditional. The enormity of this evil is fast being forced upon the public attention so that the manner in which it is being combated in the big metropolitan centers affords an interesting and profitable subject for study.

Strange to relate, when one stops to consider the breadth of interest and importance of this problem, together with the fact that so many thousands have worked on its various phases, and that so much has been written and is being written on the subject, still no coordinated effort of one group of men has been made to undertake a scientific study of the problem as a whole. One of Pittsburgh's most public-spirited citizens, a man devoted to the city's welfare, recognizing this fact, has established a fellowship of $12,000 per year with the department of industrial research of the University of Pittsburgh for the scientific investigation of this problem.

We have an unpretentious laboratory, designated as the "smoke house," a small, fireproof building, 18 feet wide and 30 feet long, which is situated at a sufficient distance from the main laboratory, so that the smoke in quantities as great as we may need in our work can be made without interfering with the other researches being carried on. In this building there is a furnace, so constructed that it is possible, by varying conditions, to get any kind of coal smoke. This statement may, perhaps, appear peculiar to those who have always considered smoke as just smoke, but our studies

of this subject reveal new properties continually. There are differences in the physical state as well as in the amounts of tar, carbon, ash, etc., in smoke made from different kinds of coal under different conditions of temperature, etc. By means of fans and motors, the smoke can be conducted to various parts of the building, where it can be used for experimental purposes in any manner desired. It is here that the physical and chemical studies are being conducted with the object of learning more definitely just what the various properties of soft coal smoke are, and endeavoring to ascertain new properties which will be of aid in the abolition of the smoke itself.

It is a well-known fact that it is possible to prevent smoke with the accompanying economy of fuel and that there are many forms of furnaces constructed which can be operated with ideal results. The obtaining of men sufficiently intelligent for their proper operation is, however, a problem difficult of solution, for the wages are small and employment far from pleasant. One of the chief aims of our experimental work is, then, to find a means of making the man in the boiler room perform his duty in the best possible manner. A mechanism is being devised, which is simple, practical and "fool-proof," that will automatically warn the stoker in the boiler room that the smoke his fire is making is in excess of the law.

Inquiry is being instituted, in the most accurate manner possible, into the true increase in the cost of living due to the damage done by smoke to the property of the residents of this smoky district. Special stress will be laid upon this portion of the investigation because of the fact that while those who have made Pittsburgh smoky may be large losers by the neglect, they are in all probability not the greatest. Among the list of sufferers upon which the burden falls, we may include dwellings, hotels, hospitals, picture galleries, museums, office buildings, banks, libraries and stores, both wholesale and retail.

The relation of smoke to the health of the residents of a smoky district is one worthy of careful consideration, and one which we hope to be able to put on a more scientific basis than the present.

It is a well-known fact that the lungs of a person dwelling in a smoky atmosphere become coated with soot particles. Does this make him more susceptible to consumption? The question has been answered both negatively and positively by different authorities. From a thorough examination it would appear that Pittsburgh did not have as much consumption as other cities similarly located, where there is much less smoke. Within the corporate limits of the city there is more consumption in the better residence portions, where there is less smoke and dirt than in the more congested district where smoke abounds. On the other hand, catarrh, pneumonia and other so-called "bad air" diseases are very prevalent, due to the irritation caused by the smoke particles. Furthermore, it has been said by some that because of the mucus swallowed in these diseases, stomach trouble is thus indirectly caused by smoke. The eyes are not immune, either. Eye specialists say that the busiest time is after a heavy fog accompanied by smoke.

From the side of æsthetics and the city beautiful, we must take up the effect of coal smoke on buildings and on plants. The botanical side of the question is one of special scientific interest, for while the relation of plants to smelter fumes, etc., has received considerable attention, little if anything seems to have been accomplished or even attempted from the standpoint of the carbon with the accompanying tar-containing phenol and other compounds of a similar nature. It may be of interest to state in this connection that I have found as high as 44 per cent. tar in samples of soot examined. Knowing this, it can well be understood that carbon smoke might have a very injurious effect on vegetation, more especially in spring, when the new leaves are appearing and things being tender are much more readily affected by the toxic action of the soot and accompanying substances.

The meteorological aspect of the smoke problem is being considered. This part of the investigation will, for the greater part, consist

of the application to our local conditions of the methods used in other places.

The smoke problem is not an easy one to handle. There are many obstacles to overcome and many prejudices to set right. Without power to act, knowledge in itself would be of little avail. Therefore the legal aspect of the situation will form no small part of our investigation.

In brief, then, we have in this research the twofold object of scientifically ascertaining the true economic status of the smoke problem in all its phases and the devising of ways and means of making the smokeless combustion of soft coal the rule rather than the exception.

R. C. BENNER

UNIVERSITY OF PITTSBURGH

CANCER RESEARCH

DURING the past winter important developments in the field of cancer research have occurred in New York City which have hitherto escaped public notice. By the addition of $100,000 to the endowment fund of the General Memorial Hospital to be used for the maintenance of 20 free beds for cancer patients, a well-known scientific man has provided the staff of the Collis P. Huntington Fund for Cancer Research with greatly increased facility for the study and treatment of cancer in the human being.

The General Memorial Hospital for the Treatment of Cancer and Allied Diseases was originally chartered for the study and treatment of cancer but at the time of its foundation, cancer had little interest to any one but the surgeon. To-day the wide field of research opened up by the experimental study of cancer is too costly to be undertaken by any hospital without an unusually liberal endowment; and it may be said that no hospital in New York possesses to-day an adequate endowment for this purpose.

The General Memorial Hospital has enjoyed the support of the Huntington Fund for Cancer Research founded by Mrs. C. P. Huntington, since 1902. The trustees of this fund, of which the late Dr. W. T. Bull was chairman, placed the fund at the disposal of Cornell University Medical College in whose laboratories systematic research has been conducted as far as the income of the fund and the resources of the university would permit. Under this arrangement three volumes of studies have been published relating chiefly to experimental observations on lower animals, but the work has been limited in scope by the lack of hospital facilities, and a close cooperation between the laboratories and the hospital wards.

The recent donor, himself a scientist of international reputation, a supporter of cancer research, both here and abroad, and fully acquainted with the proper organization of such work, determined to supply the needs of the Huntington-Cornell staff, and by his liberality has opened a portion of the General Memorial Hospital to cancer research under very favorable auspices. In addition to the endowment of 20 beds, chemical and pathological laboratories are now being constructed in the hospital and a complete X-ray and Radium department is being provided for the early diagnosis and treatment of the disease.

This latest addition to the resources of cancer research is significant in several respects. It is a noteworthy instance of the discriminating support of science by a scientific man who knows exactly what his gift may accomplish. It supplies for the first time in New York City the opportunity for men trained by a university in many branches of medical science to study this disease at the bedside. It enables the pioneer institution founded in the city for the care of malignant disease at last to enter in earnest into the field for which it was established. Incidentally it points out a way for a most effective use of much larger endowments than are even now available. Although a considerable capital is represented in the various branches of this institution, clinical cancer research has been found to be extremely costly, and even the present endowment fails to provide all the important necessities in the work.

Not the least gratifying result is that New York City is now provided with an institution similar to those recently established in

London, Berlin, Heidelberg and Paris, abroad, as well as in Buffalo, St. Louis and Boston, here, and that this institution has the advantage of having an organization of men thoroughly trained in cancer research work, which it has taken ten years to develop and bring together.

The problem of cancer is the most serious of all the problems that confront the medical profession to-day. The steady increase of the disease baffling all efforts to discover the cause or a means of controlling it has attracted the leading minds in medicine to the field of cancer research. The only hope of a solution of this great problem is by bringing to bear upon the problem, the combined efforts of every department of medical science and by having the closest affiliation between the cancer wards and the scientific laboratories of a great university. W. B. C.

THE NATIONAL ARGENTINE OBSERVATORY

Upon the recommendation of the Minister of Public Instruction the Argentine Congress has provided in its budget for 1912 a 5 foot reflecting telescope for the National Observatory at Córdoba.

It is expected to locate this telescope in the mountains to the west of and close to Córdoba where preliminary investigations have already been made and the meteorological conditions found to be good.

The program of work for this telescope comprises photographs and other investigations of the nebulæ and clusters of the southern sky, in continuation of similar work in the northern sky; photographic observations of comets, faint satellites, etc.; stellar parallax; observations of special regions of the sky; spectrographic observations with high and low dispersion and in the line of sight.

C. D. Perrine
Observatorio Nacional Argentino,
Córdoba, May 11, 1912

AN INTERNATIONAL CONGRESS OF ANTHROPOLOGY

At an International Conference called by the Royal Anthropological Institute and held June 4 in the rooms of the institute, London, immediately following the sessions of the International Congress of Americanists, it was voted to organize an international congress of the anthropological sciences, which shall either include several existing congresses or work in affiliation with them. The congresses which it is hoped may become a part of the projected congress are Congrès International d'Anthropologie et d'Archéologie Préhistoriques, International Congress of Anthropology, Congrès Internationaux d'Ethnographie, International Folk-Lore Congresses and International Congress of Americanists. The organizing committee appointed by Dr. A. P. Maudslay, president of the conference, consists of the following: Maudslay (*ex officio*), chairman, R. R. Marrett (Oxford), secretary, Hrdlička, Boas, Krämer, Capitan, Heger, Duckworth, Waxweiler, Lafone Quevedo, van Panhuys. This committee met at the close of the conference and decided that a congress should not be held before 1915 (if then). In the meantime a general committee is being constituted by gradually adding names to the organizing committee; and sub-committees are being formed to establish harmonious relations with the various existing international congresses.

George Grant MacCurdy

HONORARY DEGREES IN SCIENCE

The degrees conferred by Harvard University at its recent commencement on men of science and words used by President Lowell are as follows:

Master of arts: Charles Francis Stokes, surgeon for sailors in peace and war, on sea and land, on battleships in the west and the east and around the world; professor of surgery, director of hospitals, Surgeon-General of the Navy. Doctor of science: Frederick Forchheimer, who in his practise, by his teaching, and with his pen, has contributed to the marvellous advance of medicine in our day; a man in the judgment of his peers worthy to preside over the Association of American Physicians; Carlos de la Torre y Huerta, statesman and naturalist; first in his knowledge of the molluscs of the Gulf; discoverer of fossils who has revolutionized the geologic history of Cuba; Frederick Cheever Shattuck, a teacher of medicine, pungent

and incisive; a practitioner with the insight that makes a physician great, and with a strong man's sympathy that has brought comfort and courage to countless sufferers; Benjamin Osgood Peirce, physicist and mathematician, by whose skill in experiment and calculation intricate problems in heat and magnetism have been solved; a man of science ignorant only of his own deserts. Doctor of laws: George Washington Goethals, a soldier who has set a standard for the conduct of civic works; an administrator who has maintained security and order among a multitude of workmen in the tropics; an engineer who is completing the vast design of uniting two oceans through a peak in Darien.

The honorary degree of doctor of laws was conferred by Western Reserve University, at commencement, upon Dr. P. P. Claxton, United States Commissioner of Education; Dr. G. A. Gordon, pastor of the Old South Church, Boston, and Dr. T. C. Mendenhall. Dr. Mendenhall was presented by Dr. Frank Perkins Whitman, professor of physics, who said:

Mr. President: I present to you, that he may receive at your hands the degree of doctor of laws, Thomas Corwin Mendenhall, teacher, investigator, administrator, professor of physics, but chiefly leader and inspirer of youth in this state, and the Imperial University of Japan; effective interpreter of nature and her laws; president of two notable scientific schools; head of a great government department; leader or collaborator in many scientific undertakings of the United States. Though prevented in youth by circumstances, not according to his desire, from entering regularly on her courses of study, Professor Mendenhall is no stranger to Western Reserve, for at the old college in Hudson he found a congenial academic atmosphere, and the inspiration of high scholarly ideals, as a special student with Professor Charles A. Young. To-day Western Reserve University cordially receives him into the company of her graduates, at the summit of a career of which in the day of small beginnings she is happy to have had some part in laying the foundation.

Among recipients of the doctorate of laws from the University of Pennsylvania are the following: Joseph Swain, president of Swarthmore College, and the orator of the day; Louis A. Duhring, professor emeritus of dermatology and honorary curator of the dermatological collections of the University of Pennsylvania; James Tyson, emeritus professor of medicine at the University of Pennsylvania, and John Grier Hibben, president of Princeton University.

At its recent commencement Northwestern University conferred the degree of doctor of science on Dr. Henry Smith Carhart, emeritus professor in the University of Michigan and from 1872 to 1886 professor of physics in Northwestern University.

Brown University has conferred the honorary degree of doctor of science on Professor W. J. Hussey, director of the observatory of the University of Michigan.

SCIENTIFIC NOTES AND NEWS

THE board of scientific directors of the Rockefeller Institute for Medical Research announces the following appointments and promotions: Alexis Carrel (experimental surgery) has been promoted to the rank of member of the institute. The following associates have been made associate members for a term of three years: Peyton Rous (pathology and bacteriology), Donald Dexter Van Slyke (chemistry), Walter Abraham Jacobs (chemistry) and Frank Watts Bancroft (experimental biology). The following assistants have been made associates: Paul Franklin Clark (pathology and bacteriology), Richard Vanderhorst Lamar (pathology and bacteriology) and Hardolph Wasteneys (experimental biology). The following new appointments are announced: Harold Lindsay Amoss (assistant in pathology), Clarence J. West (assistant in chemistry), Wolfgang Ewald (fellow in experimental biology), Francis Richard Fraser (assistant resident physician and assistant in medicine), Frederic Moir Hanes (assistant resident physician and assistant in medicine).

DR. EDGAR W. OLIVE, professor of botany in the State College of South Dakota, and state botanist, has been appointed curator in the Brooklyn Botanic Garden, to have charge of the department of public instruction, and also

of the work in plant pathology. The appointment takes effect on September 1, 1912.

Captain H. G. Lyons, F.R.S., has been appointed assistant director of the Science Museum, South Kensington.

Professor Dürck, until a short time ago director of the pathologic institute at Jena, has assumed the direction of the pathologic institute at Rio de Janeiro.

The executive committee of the Entomological Society of America has named the following as additional delegates to the second International Congress of Entomology, to be held at Oxford, England, August 5 to 10, 1912: Professor Stephen A. Forbes, University of Illinois; Dr. L. O. Howard, chief, U. S. Bureau of Entomology; Dr. Wm. M. Wheeler, Harvard University; Dr. James G. Needham, Cornell University.

The former students of Professor O. Henrici, F.R.S., who recently retired from the chair of mathematics at the City and Guilds Engineering College, have had engraved in his honor a medal to be awarded annually for proficiency in mathematics.

The alumni and students of the School of Mines of the University of Pittsburgh have held a banquet in honor of Professor M. E. Wadsworth, the retiring dean of the school. In presenting a silver loving cup to him, Mr. Floyd Rose said: "In the four years during which Dr. Wadsworth has been with us he has become intimately associated with every student in the school. He has aided the weak, encouraged the despondent and won the affection of every one with whom he has come in contact. A more popular or more successful dean the university has never seen. From an insignificant department, he has developed the school of mines into one of the best schools of its kind in the country. It is a source of pleasure that, though he retires from teaching, he will remain with us as dean emeritus."

The Lucy Wharton Drexel medal of the Museum of Archeology of the University of Pennsylvania has been awarded to Dr. M. Aurel Stein for his explorations in China.

The Albert medal of the Royal Society of Arts has been awarded to the Right Hon. Lord Strathcona and Mount Royal, F.R.S., for his services in improving the railway communications, developing the resources and promoting the commerce and industry of Canada and other parts of the British empire.

Dr. Charles J. Chamberlain, of the University of Chicago, has been elected an honorary member of the Naturforschende Gesellschaft an der Kaiserl. Universität zu Kiew, Russia. Dr. Chamberlain has just returned from Australia and South Africa, where he has been making a field study of the oriental cycads and collecting material for a detailed morphological investigation.

Professor Burton E. Livingston is continuing his researches at the Desert Laboratory during the present summer. He is assisted by Mr. E. M. Harvey.

Mr. J. T. Lloyd, assistant in limnology in Cornell University, has recently gone from Colombia, where he has been spending the past six months collecting in the summits of the Andes, to Europe, where he will spend the summer visiting fresh-water biological field stations.

Henry Holmes Belfield, dean of the technological course of the high school of the University of Chicago from 1903 to 1908, and organizer of the Chicago manual training school, of which he was director until it was merged with the university high school in 1903, died in Ann Arbor, Mich., on June 5.

The United States Civil Service Commission announces an examination on July 24, to fill vacancies in the position of entomological assistant (male), at salaries ranging from $1,400 to $1,800 per annum, in the Bureau of Entomology, Department of Agriculture, Washington, D. C.

A research laboratory is being planned for the National Jewish Hospital for Consumptives at Denver, to cost about $100,000.

The nineteenth International Congress of Americanists to be held in 1914 will consist

of two sessions: the first in Washington, D. C., and the second at La Paz, Bolivia.

THE Paris correspondent of the *Journal* of the American Medical Association writes that the *Journal Officiel* has recently published very discouraging statistics on the French population in 1911. In 1911, there was an excess of 34,869 deaths while the year before there was an excess of 71,418 births. This difference is due, on one side, to the diminution of births (742,114 infants reported living in 1911 against 774,390 in 1910) and, on the other side, to the increase in the number of deaths (74,011 greater in 1911 than in 1910). The deaths have been more numerous in 1911 than in 1910 in almost all the departments. In proportion to the population, the Norman departments, as in the preceding years, furnished the greatest mortality. The notable increase in the proportional number of deaths in France as compared with many other countries is because France is one of the countries in which there are the greatest number of aged people and chiefly because of the small birth-rate of recent years. Although the birth-rate is low, France is among the countries in which the number of marriages is relatively large. In 1911, 307,788 marriages were registered. The constantly increasing number of divorces reached 13,058, slightly more than in 1910. The birth-rate is low in many countries at the present time, but in no country is it so low as in France. Among the many measures suggested to check this increasing depopulation, the most recent is the proposal which M. Messimy, former minister of war, has made to the bureau of the chamber of deputies. M. Messimy believes that a premium at the birth of every child born of the same mother, reckoning from the fourth, would increase the number of births. This premium would be $100 (500 francs), of which one half would be paid to the mother at the birth of the child and the other half deposited in the national pay-office for pensions, in order to insure her an income from it during life. The mother could, however, collect the sum at once, or devote it to assure herself a subsequent pension, which, in this case, would naturally be much greater. In order to meet the expenses which the premium of 500 francs or subsequent annual income would involve, M. Messimy proposes either to resort, entirely or partially, to the regular budget-resources or to place a special tax on bachelors as well as on heads of families without children or having only one child.

A CIRCULAR by the National Bureau of Standards, Department of Commerce and Labor, on the measurements of length and area, including thermal expansion, is in press. It supersedes a similar circular issued July 1, 1909. The new regulations and fees will go into effect May 1. The bureau gives notice that it will be glad to cooperate with investigators, manufacturers and others, not only in executing tests of the highest precision, but also, on request, in furnishing any information at its disposal concerning methods of measurement, the relations among and the legal status of units, the requirements that accurate standards should fulfill, and the design and construction of special apparatus. The bureau will not accept for tests standards and apparatus likely to change excessively or that can be checked with ordinary facilities, such as poorly divided scales or scales graduated on wood, celluloid or paper. A certain minimum of quality will be insisted upon to admit to test. The circular defines the conditions influencing the dimensions of bodies and also describes the fundamental unit of length. It refers to the interrelation of secondary and special units of length and area, with tables of equivalents added, and also devotes some space to a description of national prototype meters, of which it has accurate copies. For the routine work of testing use is made of secondary or working standards whose values are carefully determined by comparison with the bureau's prototype meter from time to time to detect any possible changes. These working standards include multiples and submultiples of the meter and of the yard. Methods of comparison of length standards are outlined and the classification

and nature of tests are defined. The circular concludes with general instructions to applicants for tests and gives the schedule of fees for reference standards, working standards, commercial standards, metal tapes, contact standards, precision screws and calipers, areas and area measuring instruments and thermal expansion of materials. For educational and scientific institutions and societies a discount of 50 per cent. will be allowed on all tests under the schedules stated.

UNIVERSITY AND EDUCATIONAL NEWS

Sir Julius Wernher bequeathed £250,000 to the treasurer of the Union of South Africa for the purpose of assisting in building, and, if sufficient, partly endowing, a university at Groote Schuur, near Cape Town, and £100,000 to the Imperial College of Science and Technology, South Kensington, together with two-twelfth parts of his residuary estate, but not exceeding £50,000.

Professor Newton H. Winchell, of Minneapolis, for many years state geologist of the Minnesota Geological and Natural History Survey, has presented his geological library to the University of Minnesota. This library is probably one of the best private collections of geological literature in this country and was built up through the years when Professor Winchell, as editor of the *American Geologist*, had unusual opportunities for obtaining the earlier serial and regional reports of this and foreign countries. Many of its volumes are priceless. The library is now being installed in the department of geology at the University of Minnesota and will be known as the "Winchell Library of Geology," to which hereafter donations and exchanges should be addressed.

Dr. Eugene L. Opie, professor of pathology in Washington University, has been appointed dean of the medical school to succeed Dr. George Dock, relieved of this duty at his own request.

Samuel N. Spring, forester of Connecticut and lecturer in the Yale Forest School, has been appointed professor of forestry in the New York State College of Agriculture, Cornell University.

Dr. J. W. Jenks, professor of political economy at Cornell University since 1891, will become professor of government and public administration and director of political studies in the School of Commerce, Accounts and Finance of New York University.

Dean Walter R. Crane, of the School of Mines, Pennsylvania State College, has been granted a year's leave of absence and left June 13 to spend the coming year in the study of the coal fields of Alaska and the northwest. Dr. Elwood S. Moore, professor of geology, will be acting dean during Dr. Crane's absence. Assistant Professor Thomas C. Brown, department of geology, has resigned to accept a similar position at Bryn Mawr College. Mr. H. N. Eaton, instructor in geology and petrography, University of Pittsburgh, has been appointed to succeed him. Associate Professor of Mining William M. Weigel has resigned to accept the position of general superintendent of the North American Smelting Company, Ltd., Kingston, Ontario, Canada. Hugh D. Pallister, instructor in metallurgy, has been appointed to succeed Professor Weigel with the title of assistant professor of mining. Harry B. Northrup and William A. Royce have been promoted from assistants to instructors in mining. Carroll A. Garner has been appointed instructor in mining.

The following appointments have been made for the coming year in the North Carolina College of Agriculture and Mechanic Arts: instructor in chemistry, J. W. Nowell, A.B. (Wake Forest), Ph.D. (Hopkins), and F. B. Sherwood, B.S. (North Carolina College).

At the Indiana University the following promotions from assistant professorships to associate professorships have been made: Robert D. Carmichael, in mathematics; Melvin E. Haggerty, in psychology; Clarence E. May and Frank C. Mathers, in chemistry; Fernandus Payne, in zoology.

Dr. Daniel Starch has been promoted to the rank of assistant professor of psychology at the University of Wisconsin.

DR. JOHN SATTERLY has been appointed lecturer in physics at the University of Toronto.

MISS CARRIE M. DERICK, who has been acting-head of the department of botany at McGill University, Montreal, for two years, has been appointed professor of morphological botany. She is the first woman who has been made a full professor in a Canadian university.

DISCUSSION AND CORRESPONDENCE

OBLIQUE ORIENTATION OF MAPS AND HALF-TONES

IT is a well-nigh universal custom of cartographers, in constructing maps on the orthogonal, conic, or any other projection with converging meridians, to draw the central meridian straight in each case and place it parallel to the lateral edges of the paper, except when dealing with small areas considerably elongated in a direction oblique to the meridians, such as Manhattan Island or some portions of the coast. In recent years, however, there have appeared in scientific literature quite a number of sketch-maps of the eastern United States with the central meridian inclined several degrees to the perpendicular, without any apology or explanation. One of the latest examples is the map of the chestnut-bark disease on page 420 of SCIENCE for March 15, 1912.

Evidently the persons who have submitted such maps for publication simply took base-maps of the whole United States and cut them parallel to the edges without taking the trouble to orient them in accordance with the cartographic principle above mentioned, and the result is rather offensive to the eye of the geographer. In the case mentioned less than half the original base-map was used, with the result that even the western edge of the published map is inclined a little to the left, and the central meridian is about 10° out of plumb. (There is a correctly oriented map on page 406 of the same issue of SCIENCE.)

Of course if the meridians were shown on such maps their curvature (in some of the projections commonly employed) would still reveal the fact that part of the original had been cut away, even if the central meridian of the part used were placed as nearly upright as possible; but on the maps in question the meridians are not shown, and there are no north-and-south lines long enough to have any perceptible curvature. Neither is there any horizontal lettering that had to be kept in the same position when the map was trimmed; and even if there was a legend in one corner it would be a simple matter to cut it out and place it in a new position.

A somewhat similar disregard for appearances is often exhibited by persons who use half-tone illustrations. It goes without saying that a rectangular photograph should have its horizon (if any) and all its vertical lines parallel to its edges, unless there is some special reason for treating it otherwise; but photographs several degrees out of plumb are very often published in text-books, scientific reports and magazines, even in some magazines which seem to take pride in the quality of their illustrations.

The principal cause of this rather annoying condition is probably in many cases too much division of responsibility. A traveler who makes photographs, especially if he is working for some institution which pays his expenses and furnishes the photographic material, often has them developed and printed without his personal supervision, by some human "machine" who treats all the views alike, no matter if some of them are a little out of plumb, as is almost certain to be the case, especially with snap-shots. When the time comes to supply illustrations for a manuscript the average author perhaps looks over his negatives, or a list of them, and gives orders for prints of certain ones, without noticing that some might be improved by judicious trimming, either to make the horizon level or to cut out superfluous portions. Then the editor, even if he notices that some of the prints need trimming, may be too busy to attend to it, or more likely not equipped with suitable apparatus, so he passes them on to the engraver, who naturally reproduces each picture just as it is, in the absence of instructions to the contrary.

The publication of such "eye-sores" can be so easily prevented by either author, editor or engraver that it should not be allowed to continue any longer. Of course in some cases, as in views of lakes and rivers, there may not be any distinct vertical or horizontal lines to guide the trimmer; but in such cases one may sometimes get his bearings by remembering that any point and its reflection in a body of still water are always in the same vertical line, except in the case of objects (such as birds) moving rapidly from the observer's right to left, or *vice versa*, and photographed with a focal-plane shutter traveling vertically.

Roland M. Harper

University, Ala.

ANOTHER SEX-LIMITED CHARACTER

To the Editor of Science: From work done this spring on the inheritance of mammæ in swine, the writer has apparently discovered a new sex-limited character in the behavior of rudimentaries. These rudimentaries are the ones located low on the scrotum of the male, and well to the rear on the inside of the thigh of the female. The method of inheritance corresponds to the appearance of horns in Wood's crosses in sheep.

The males used by the writer both possessed rudimentaries on the scrotum and were heterozygous in nature if the interpretation is correct. Two ages of sows were used, gilts or sows just turned a year old, and sows that had just become two years of age. The results are depicted in the following table, the symbols being as follows: *R* equals factor for presence of rudimentary, *r* equals absence of same. *RR* equals rudimentaries in both sexes, *Rr* equals presence in male and absence in female, and *rr* equals absence in both sexes.

In the second table the deviation of the actual from the theoretical is wider than the writer would like, but is scarcely significant. The number of gilts are only seventeen and the average of pigs per gilt is less than with the sows. Both of these factors should complicate the results as to chance. Since there is no appearance of rudimentaries where they are not expected the writer feels that the theory is justified in spite of the deviations.

SOWS MATED TO OLD BOAR (*Rr*)

Gametic Composition Sows	No. Sows		Boars		Sows	
			Absent	Present	Absent	Present
RR	5	Expectation	0	26	11	11
		Actual	0	26	14	9
Rr.....	9	Expectation	9	27	36	12
		Actual	11	25	34	14
rr	18	Expectation	46	46	84	0
		Actual	48	45	84	0

GILTS MATED TO YOUNG BOAR (*Rr*)

RR	4	Expectation	0	13	8	8
		Actual	0	13	13	4
Rr.....	5	Expectation	5	15	21	7
		Actual	7	13	18	10
rr	8	Expectation	19	19	23	0
		Actual	23	15	23	0

The gilts are from the sows listed in the first table and thus there are available three generations for study. The gametic composition assigned the gilts as a result of their behavior in breeding is confirmatory in every case of the composition assigned the sows.

The writer is not dogmatic in his interpretation and welcomes suggestions that may help reconcile the slight differences present.

Edward N. Wentworth

Ames, Iowa

SCIENTIFIC BOOKS

Phylogeny of the Echini with a Revision of Palæozoic Species. By Robert Tracy Jackson. Memoirs of the Boston Society of Natural History, Vol. 7. Boston: Printed for the Society with aid from the Gurdon Saltonstall Fund, January, 1912. Quarto, 491 pages with 256 text-figures and 76 plates.

The discovery of the actual phylogeny of any group of animals involves not only the combined study of the morphology and development of those animals as they exist to-day, but also the more difficult and laborious study of their fossil remains. The true phylogenist

is seriously handicapped when he deals with a group, which is poorly represented in nature's great museum, the earth's crust, and happy is he if he can find abundant material in that wonderful storehouse. Doubly fortunate is he if his training enables him to get the most from such material. One of the greatest absurdities of our persistent and no doubt necessary tendency to classify men as well as objects is the grouping by themselves as "paleontologists" those who have had this training and who specialize in the study of fossil organisms. For if a man who uses as his material the long-dead and oftentimes badly preserved animals of our museums is a zoologist, is not the man who studies in the same way similar remains preserved in the strata of the earth, just as truly one? Do either the length of time since the death of the animal or the method by which its remains have been preserved matter? Perhaps a line might be drawn between those who study fossils simply as indicators of geological horizons having in view the history of the earth as an object by itself, and those who study them as the remains of living beings whose structure throws light on the problems of phylogeny, but the latter at least are zoologists (or botanists, as the case may be) and when they combine with their paleozoology thorough knowledge of the structure and development of Recent animals, they make the best possible phylogenists. When such a worker selects for study a small sharply-defined group with a rich geological history and abundant Recent material available, and devotes years of time and the most unflagging industry to his task, the results can not fail to be of prime importance to zoologists of all sorts, everywhere.

Few groups of animals are better adapted for such study than the echini. So sharply defined is the class that its ancestry is hidden in oblivion and not a single connecting link with any other class is known. There is no animal either Recent or fossil of which it can not be affirmed either "this is" or "this is not an echinoid." Moreover, the class is relatively small, only about five hundred living species being known with perhaps three times as many fossil. The latter occur in all geological periods from the Ordovician to the Recent. Much of this material is beautifully preserved too, at least so far as essential structures go, for the hard test and lantern of a sea-urchin are exceptionally satisfactory objects for geological preservation. Finally sea-urchins have long been favorite objects of study, and their anatomy, development and life history are as well known as those of any marine invertebrates. If, therefore, the investigation be undertaken by the right man, the possibility of really working out the history of the group, were unusually favorable, and it is but the simple truth to say that in his "Phylogeny of the Echini" Dr. R. T. Jackson has shown himself to be that man. This monumental work sets forth the actual developmental and evolutionary history of the echini so fully, so fairly and so convincingly that it may be said with little fear of contradiction, there is no other group of animals of equal importance the main lines of whose phylogeny are more definitely and certainly known. Moreover so extraordinary is the amount of accumulated fact and so suggestive are the interpretations offered that there is something of interest in the volume for every one attracted by the problems of evolution, be he zoologist or botanist.

The book is dedicated most appropriately to Alexander Agassiz and Alpheus Hyatt, the former the Nestor of students of echini, the latter the originator or promoter of the principles and methods to which Jackson is himself so ardently loyal. Indeed the most striking characteristics of the volume are the emphasis placed on "stages in development" and the persistence with which the facts are marshalled in support of the "recapitulation theory." Those who deny the existence of stages and the validity of the recapitulation theory will find it exceedingly difficult, if not impossible, to meet the arguments and interpretations with which the writer defends his position. Second only to the emphasis on stages is the stress laid on variation and its significance. In the introductory pages, variations are grouped under five heads (*arrested,*

regressive, progressive, parallel, aberrant) and the meaning of each term is clearly explained. That variation is nearly always significant and that its significance may be determined are two cardinal principles which the reader of this book can scarcely doubt.

The terminology adopted by Jackson is as free from technicalities as possible and there are scarcely any new terms introduced. Those which are proposed, as for example "mid-zone," are simple, readily understood and meet a real need. In the case of such terms as have been used in different senses by previous authors, as "peristome," Jackson has adopted that usage which has appealed to him as simplest and least open to misunderstanding, and consequently even those who prefer a different sense can not mistake his meaning.

The extensive investigations which Jackson has made into the morphology of Recent echini have led him to some interesting discoveries of structures hitherto overlooked. A notable illustration of this is the presence or absence of pits in the upper end of the half-pyramids which compose the lantern. These pits have apparently been overlooked hitherto, though they seem to be of real systematic importance and even of ordinal value.

In his choice of generic and specific names Jackson has followed the International Code, but not at the expense of his judgment or common sense. As an illustration of his mental attitude, his sensible treatment of *Archæocidaris vs. Echinocrinus* is illuminative. Nobody questions that *Echinocrinus* has priority, but Jackson well says: "This name, however, is misleading, was based by Professor Agassiz on a misconception of affinities and has been abandoned for some sixty years in favor of the entirely appropriate *Archæocidaris* of McCoy. . . . To revive the old name *Echinocrinus* . . . will make confusion at present and in future, and no gain to any one." Another taxonomic snarl which Jackson has courageously untangled is that involving the name *Diadema*. For years it has been known that this name belongs to a cirriped, although it has also been in use for a genus of butterflies and for one of the best-known genera of tropical sea-urchins. Students of the echini have persisted in its use and a family and an ordinal name based upon it are both universally adopted. Jackson's statement of the case (p. 27) is clear and convincing and his proposed substitutes *Centrechinus, Centrechinidæ* and *Centrechinoida* are appropriate and euphonious. Now that the Gordian knot is cut, it is to be hoped that zoologists will no longer use *Diadema* for either sea-urchin or butterfly.

Following his introductory pages, Jackson divides his book into three parts. The first of these is entitled "Comparative Morphology of Echini." It includes 168 pages, crowded with observations and interpretations of the typical structure of the test and lantern, and variations therefrom. One notes the absence of any discussion of the pedicellariæ and of the non-calcareous organs, but as these parts seem to have little phylogenetic significance the omission is perhaps not important. We may, however, hope that some zoologist will be moved to institute ere long a similar thorough comparative study of these less significant systems. So far as the pedicellariæ are concerned, Mortensen already has accumulated a mass of important material. Jackson's opening paragraph is a fine defense of the claim that paleozoology is only one aspect of zoology. Then follow sections on the form of the test, orientation, the pentamerous system and variation therefrom, the structure of the skeleton, growth, ambulacrum of the corona, interambulacrum, basicoronal plates, imbrication, spines, peristome, ocular and genital plates, periproct, Aristotle's lantern and perignathic girdle. It is impossible in a review like this to give any adequate conception of the wealth of these sections; only the most striking features may be noted. The repeated references to Lovén and his work show in what high esteem he is held, while the constant emphasis on the significance of both normal structures and variations is very noticeable. Variants from pentamerous symmetry are shown to be exceedingly rare; only 25 were recorded prior to Jackson's work, but he has studied 71, of which 60 were found in the fifty thousand Recent echini personally examined by him.

He arranges these variants in twenty groups, showing that tetramerous specimens, though rarely completely symmetrical, are the most common. The study of both normal and variant tests led Jackson to the conclusion that the interambulacral plates are merely space fillers and always originate against the oculars. He therefore holds that the test of a sea-urchin consists, not of ten equally important areas, but of *five* only. Each of these is capped by an ocular plate, beneath which arise the two columns of ambulacral plates with one or more columns of space-filling interambulacrals on either side. The growth of the test seems to take place chiefly on its outer surface. That the inner is more primitive is pointed out and demonstrated by interesting evidence. Much stress is laid on resorption of the calcareous matter during growth as a developmental factor, particularly in relation to the peristome. The matter of imbrication or non-imbrication of coronal plates is not considered to be of special phylogenetic importance. The covering of the peristome is carefully considered and six different types are pointed out. A new term, "non-ambulacral," is introduced in this connection, which is to be welcomed as accurate and useful; it is applied to those plates of the peristome which are not homologous with any of the coronal plates.

The section discussing the mutual relationships of ocular and genital plates occupies 79 pages and is one of the most remarkable contributions to echinoid morphology which has yet been made. With a patience and zeal most extraordinary, Jackson has personally studied fifty thousand specimens of 137 species of Mesozoic and Recent regular echini and has thus inspected, not hastily and casually, but with real care, a half million genital and ocular plates! Certainly results and opinions reached after such a study are worthy of more than ordinary consideration. The chief conclusions to which the author comes are as follows:

1. The position of oculars and genitals with reference to each other and to the periproct is not dependent on size or age in adults, but is a species character. Of course, like all specific characters it is more firmly fixed in some cases than in others, but in only a very few cases is there any room for question as to what the species character in this particular is. From a purely taxonomic standpoint this discovery is of very great importance, but its chief interest lies in its phylogenetic bearings, upon which Jackson very properly lays particular emphasis.

2. In Recent regular Echini (except perhaps the Aspidodiadematidæ) the oculars in very young individuals are all exsert (*i. e.*, not in contact with the periproct); they are shut out by the five genitals forming a closed ring. As the individual grows, however, one or more, even all, may become insert (*i. e.*, reach and touch the periproct) thus separating the adjoining genitals. The species character is, however, reached very early in life in most echini, when the individual is less than half grown, often when it is still but a few millimeters across. Even the variants which progress beyond the species character are found almost wholly among the small specimens. Exceptionally large and fine specimens generally show the species character.

3. Of the 32 possible arrangements of ocular plates with reference to the genitals, ranging from all exsert to all insert, only 22 were found and of these 14 were so rare that they all together characterized only about 1.5 per cent. of the specimens. The other eight have a very fixed and characteristic order of appearance. For example if two oculars only are insert in the adult, they are the two of the bivium (*i. e.*, oculars I., V.); if three, they are these two plus ocular IV., and if four, they are these three plus ocular II. The variations from this sequence are exceedingly interesting and important and are very fully discussed.

4. The first ocular to become insert appears to indicate a family character; it is usually ocular I., but in the Cidaridæ, in the Arbaciidæ and also in the Echinometridæ it is ocular V.

5. While the very small apical system of the Echinometridæ shows that a highly specialized family does not necessarily have a large apical disk, with oculars all insert, it appears to be

true that within any given family the most specialized genus, and within any genus the most specialized species, has the largest number of insert oculars.

Aside from these important general conclusions, mention should be made of the occurrence of what may be called "right-oculared" sea-urchins in species which normally are "left-oculared," *i. e.*, some individuals have oculars I., V., II. insert, when I., V., IV. is the species character. Also deserving of special note are the remarkable peculiarities of the echini of the west coast of South America. Particular attention should be called to the invaluable tables on pages 100, 142, 143 and 154–164 and to the diagram (Fig. 176) on page 153. The detailed studies of the development of the apical disk in *Strongylocentrotus dröbachiensis* and of geographical variation in that species and several others, notably *Tripneustes esculentus*, deserve far more than the passing commendation possible here.

A discussion of the special characters of genital plates occupies pages 165–173, among the interesting points considered being the exclusion of genitals from the periproct, the fusion and splitting of genital plates, and the number and position of the genital and madreporic pores. The characteristics of the periproct occupy four pages and the very important point is emphasized that the so-called suranal plate is not a primitive but a secondary feature. More than twenty pages are filled with a discussion of the "Aristotle's lantern," including its muscles, and the perignathic girdle which is really a part of the same organic system. The pits, already mentioned, which were discovered in the tops of the half-pyramids of the Centrechinoida, are described here. Stress is laid on the importance of the structure of the lantern and teeth for purposes of classification and the Centrechinoida is divided into three very satisfactory suborders (*Aulodonta, Stirodonta, Camarodonta*) based primarily on these characters. The fundamental differences between auricles and apophyses are clearly pointed out and all the known varieties of each are discussed. One finishes the reading of this first part of the volume with amazement at the array of facts it contains and with admiration at the way in which they are marshalled and the common sense with which the conclusions are drawn. There is no attempt to be startling and the newly discovered facts are not made the bases of wild hypotheses, but each theoretical conclusion is presented with the facts in support of it so fairly, so open-mindedly, as to carry great conviction.

To the taxonomist Part II., "Systematic Classification of Echini," which fills pages 199–234, will prove of particular interest. The author begins with a brief statement regarding his inability to accept Dr. Mortensen's divisions based on differences in the pedicellariæ and states the principles which have guided him. The recently suggested close relationship between echini and crinoids is emphatically disapproved, nor is any direct connection between sea-urchins and starfishes deemed at all probable. The original stock from which the echini have sprung is very likely to be found among cystoids. The "Key" beginning on page 201 includes all the orders of echini accepted or proposed by the author, all the families of regular Recent echini and all the families and genera of the Paleozoic era. This key is very fully elaborated, so that it is far more than the ordinary key. It might perhaps be called a synopsis, but as it is arranged in the customary dichotomous form it is very usable and will prove most helpful to all workers on either Recent or fossil echini. Nothing of the kind has hitherto been available and the need has often been sorely felt. On page 209 is given a remarkable "bird's-eye view" of the phylogeny of the echini as worked out by Jackson. This family tree well deserves most careful study and brings home to the reader certain fundamental conclusions of the author which may be briefly stated here. (1) *Bothriocidaris* is the nearest known approach to the primitive echinoid stock and serves as the root, or, perhaps better, the trunk of the tree. (2) The remaining characteristic Paleozoic forms are not in any sense ancestral to our modern

echini, but represent totally different branches which reach their culmination in the Permian. (3) The Bothriocidaroid stock was the origin of a Cidaroid branch, which in turn gave rise to the Centrechinoida, and from this order all the other Recent echini have sprung. So firmly has Jackson grounded these conclusions on the facts of morphology, embryology and paleontology that it is difficult indeed to doubt their essential truth. Of course the time-honored divisions Palæechinoidea and Euechinoidea no longer have any use since they are artificial and unnatural.

Following the key are detailed accounts of each of the groups given therein. Part of this can not avoid being elaborated repetition, but there is added much that is important or suggestive, particularly concerning the interrelationships of the different groups. Great importance is very naturally given to the structure of *Bothriocidaris,* which is emphatically stated to be "the most primitive type of echini." Four new genera from the Paleozoic are described and their relationship to previously known forms is clearly brought out. The progressiveness of structure in the Palæechinidæ is emphasized and the ascending series is beautifully worked out, forming one of the most convincing demonstrations of "stages" imaginable. In this connection figure 237 on page 231 deserves special mention.

In Part III., "Paleozoic Echini," is to be found the more distinctively systematic and paleontological portion of Jackson's work, but it would be a great mistake for the phylogenist or student of variation to feel he could pass over this part superficially. It is crowded with details of morphology and of variation that are of very real importance. Besides forty species of *Archæocidaris,* most of which are based on fragments of spines or scattered plates, Jackson accepts eighty species of Paleozoic echini, grouped in 23 genera. Of these species, 22 are here described for the first time. The genera are grouped in eight families under four orders, but the Perischoechinoida with four families includes all the characteristic Paleozoic forms, of which satisfactory material is known, except *Bothriocidaris.* (The Cidaroida of course are not characteristic of the Paleozoic and the structure of the Echinocystoida can not be considered satisfactorily known.) After a brief introductory note there is an interesting chapter on "Geological Distribution" which will prove of particular interest to all who have little knowledge of paleozoology. Then follow the orders, families, genera and species in regular sequence for 208 pages. In view of its importance in Jackson's scheme, *Bothriocidaris* is again given particular attention. The very interesting fact is noted that this rare and extraordinary fossil was figured by Aldrovandus in 1618. Under the Cidaroida is given the description of a new species of *Miocidaris* from the Lower Carboniferous of Colorado. The discovery of this species is of the greatest interest and from Jackson's point of view of special importance. For the only argument against his phylogeny of the echini which presented serious difficulty was the apparent nonexistence before the Permian of echini with only two columns of interambulacral plates. While appeal might have been made with perfect propriety to the "imperfection of the geological record," that last resort of all hard-pressed phylogenists, it is far more satisfactory to have this beautifully preserved cidarid as tangible evidence of the existence of the order so far back in the Paleozoic.

In the consideration of *Palæodiscus,* the extraordinary interpretation placed on its structure by Sollas and Spencer is rejected and a perfectly natural explanation is offered of the appearance which has led to the unfortunate belief that the fossil represents a sort of connecting link between sea-urchins and starfishes. To make his record of Paleozoic forms complete, Jackson has included some forty species of *Archæocidaris* largely based on fragments but he is the first to admit (pp. 256, 257) that most of these have little paleontological, less systematic and no morphological interest. Of the new genera *Hyattechinus,* with three remarkable species, two of them new, is the most noteworthy as it has the largest number of columns of interambulacral plates known

among echini and the form of the test is, in each species, unusual. The genus similarly named in honor of Lovén is less remarkable, but is of interest because it forms one of the steps in the progressive differentiation of the Palæechinidæ. In this series, *Lovénechinus* is intermediate between *Maccoya* and *Oligoporus*. Under *Melonechinus* (this name having to replace the more familiar *Melonites*, which is preoccupied) particular stress is laid on the support which the study of that genus with its fourteen species gives to the recapitulation theory. The last genus discussed, *Meekechinus*, is a new one and like *Hyattechinus* of special interest, but in this case it is the ambulacra which are highly specialized, having in each area twenty columns of plates. The teeth also are remarkable in being serrate. Altogether this striking Permian genus is a fitting climax to the remarkable series of forms beginning in the Ordovician with *Bothriocidaris*. While no one will question the right of Hyatt, Lovén and Meek to the honor Dr. Jackson has done them in connecting their names with these interesting echini, those of us who are utterly opposed to the mixing of honor and sentiment with taxonomy must regret that impersonal generic names were not preferred.

In compiling such a systematic monograph as is presented in Part III., one invariably finds forms so imperfectly described or so incompletely known that it is virtually impossible to determine their relationship to those better known. Jackson has very wisely gathered these unsatisfactorily known forms among Paleozoic echini under two heads, "Incertæ Sedis" and "Nomina Nuda." Under the former are listed 35 species based on single plates, fragments of spines or incomplete and badly preserved tests. Many of these can be referred correctly to the family and some even to the genus, but, as their real relationship to the known forms can not be determined, it is a great advantage to have them listed in this way and not intercalated among the valid species where their dubious nature might easily be overlooked. There are eleven Nomina Nuda listed, of which *Heterocidaris keokuk* and *lævispina* Hall have a curious history, here given by Jackson in full. A half a dozen unrecognizable fossils, three of which may be Cystoids, are listed under the heading "Paleozoic Forms incorrectly referred to Echini." A very full bibliography of 248 titles and an equally satisfactory index covering 17 pages complete the book.

A special word is demanded by the illustrations with which the memoir abounds and which are as fine as they are abundant. With four unimportant exceptions, every Paleozoic species accepted in the text is figured and of many species particularly the more important forms, both photographs and drawings are used to show the appearance and structure. Moreover a large proportion of the figures are from the type specimens. The morphology of the test and lantern of Recent species is lavishly illustrated and interesting variants are equally well shown. Particular attention should be called to the "summary figures," if such a term may be used, showing important morphological characters as they appear in different groups of echini. Of these, that on page 54 illustrating the features of the ambulacra, the one on page 80 showing the various kinds of peristome and that on page 184, which gives the different characters of lantern and teeth, are of particular importance, but the others on pages 70, 134, 148, 193 and 197 are really of no less value.

The chief fault of the book, if one must be discovered, would seem to be occasionally unnecessary reiteration. This is of course only an exaggeration of a virtue due to the author's desire to set forth his facts with perfect clearness and to marshal them in vigorous support of "stages" and the recapitulation theory. The same facts or group of facts are sometimes repeated in several different places, though usually from different points of view. This is in part due to the arrangement of the book, by which general morphology is discussed first and is followed by the application to taxonomy and the detailed study of the Paleozoic forms. Of course the latter sections necessarily contain a large amount of morphological detail involving considerable

repetition. But the fault seems to be due also to a fear that the reader will have forgotten or overlooked or misunderstood the significance of something the author considers of great importance. This desire to be perfectly understood leads to an exceptionally large number of references to plates and figures and to other passages in the text, so that the reading tends to become slow and laborious, or if the references be ignored, it tends to be superficial. In the explanation of the plates, the author's care for details is shown to a marked degree. It is safe to say one rarely sees a volume in which the explanatory text for the plates is so complete. So far as the statements or interpretations of facts are concerned, the author's freedom from obvious error and from ill-judged conclusions is really remarkable. In all his references to other workers, Jackson shows not only an open-mindedness and fairness of judgment, but a courtesy even in disagreement that is delightful. At the same time, there is no glossing over of mistakes in earlier publications, no matter whether made by himself or some other authority. The perfectly evident desire to know the facts as they really are wins the reader's confidence and the unusual freedom from ambiguity prevents any misunderstandings.

The typographical work reflects the greatest credit on the Cosmos Press, especially when one considers the numerous tables with percentages often worked out to two decimals and the abundance of scientific names and technical terms. That slips of the pen and occasional transposed letters should occur is inevitable; the extraordinary thing is how very few there are in this volume. Nearly all have been detected and gathered together on the page of "Errata and Addenda" which follows the index, but they are mostly so trivial as to be of absolutely no importance. On page 188, however, the phrase "distinct continuous base" carries no meaning and we are therefore glad to have the Errata explain that it should read "discontinuous base." On page 251, we are told by the Errata, the words "starfish" and "sea-urchin" have been transposed in the author's discussion of *Paleodiscus*, an error which if uncorrected would seriously affect the argument. Two slips not noted in the "Errata," although not of great importance, may perhaps be worth pointing out. On page 121, in the footnote it is said that *Toxopneustes atlanticus* was described by Mr. Agassiz as *Leptechinus atlanticus;* the generic name should read *Lytechinus.* On page 238, the order Bothriocidaroida is inadvertently attributed to Jackson, 1896, whereas Duncan introduced the term in 1889.

When Alexander Agassiz's "Revision of the Echini" was published in 1872–74, it marked an epoch in the study of sea-urchins. It has literally been the foundation of all subsequent work throughout the world. It brought together and summarized the knowledge of echini as it stood at that time and much of the work it involved need never be done again. Jackson's "Phylogeny of the Echini" is a similar summing up of our knowledge to-day from the twentieth-century point of view and, like the "Revision," it marks an epoch. We are all to be congratulated that this fitting companion volume to the "Revision" is the work of an American zoologist; the Boston Society of Natural History is to be congratulated on the publication of a memoir of such unusual merit; and Dr. Jackson himself is most of all to be felicitated on the production of such a profound and masterly piece of research.

HUBERT LYMAN CLARK

The Parasitic Amœbæ of Man. By CHARLES F. CRAIG, M.D., Captain, Medical Corps, U. S. Army. 1911. J. B. Lippincott Company. Pp. 253. $2.50.

This book has no doubt been welcomed by many medical men, for it brings together the scattered literature in a complex field. In making such a compilation it is natural, perhaps, that the author should be biased by his own investigations. However, it is unfortunate that this fixed attitude should be so much in evidence throughout a work the purpose of which is to aid medical men in their studies of amœbic infections. A more critical

and less positive method of presentation would have increased the value of the work.

On the whole, the descriptive portions of the work, covering the morphology, biology, classification, nomenclature and species of parasitic amœbæ, are excellently executed and well illustrated.

A firm belief in the stability of the parasitic species *Entamœba histolytica, E. coli* and *E. tetragena* and the ease with which they may be differentiated on morphological grounds, provided one has studied them long enough, is made evident by the author. In the historical review it is said that Councilman and Lafleur gave "a most excellent description of the parasite now known as *Entamœba histolytica.*" This is done in spite of the admission that comparatively recent researches have shown that species determination must rest mainly upon a knowledge of the reproductive cycle. Again, the author is not very consistent in including in his list of unquestionable species half a dozen organisms the life cycles of which have been only incompletely studied.

No adequate discussion is made of the possible adaptability of amœbæ to a parasitic existence, although on *a priori* grounds one would suspect that some such process might still be taking place in nature. The answer to this question is evidently of the greatest importance from the standpoint of the prophylaxis of amœbiasis. The only extensive experiments made to adapt amœbæ to a parasitic existence have been performed by Musgrave and Clegg in Manila. In criticizing the experiments performed by these investigators the author is rather indefinite and dismisses the importance of their work from the reader's mind by stating that "while lesions were undoubtedly produced by the mixed cultures of amœbæ and bacteria, the authors could not, with their methods, be sure of excluding the spores of *E. histolytica* or the encysted forms of other amœbæ pathogenic to the animals used in their experiments" (p. 63). Later (p. 66) he lays stress upon the feeding of "pathogenic bacteria" along with the cultivated amœbæ—in spite of the fact that it is well known that the typhoid bacillus and cholera spirillum are not pathogenic when fed to the species of monkey used (*Macacus cynomolgus*). Certainly one can not criticize the cultures of amœbæ used by Musgrave and Clegg, for these were the descendants of a single amœba growing in "pure mixed culture" with a single species of bacterium. If it is argued that their animals were infected naturally either before or after the experimental feedings, then it must be shown that spontaneous amœbiasis is of such frequent occurrence in monkeys in Manila as to render these animals worthless for experimental purposes.

Again this state of mind is exhibited in discussing the cultivability of the parasitic amœbæ: "What I have always believed and stated, *i. e.*, that the parasitic amœbæ of man have not been cultivated" as Craig says, he believes to be supported by the recent work of Whitmore, who took cultures he obtained in Manila to Hartmann's laboratory and found them all to be free living species. Yet he makes no mention of the work of Fantham, whose article is quoted in his bibliography, to the effect that, by special cultural methods, he was able to identify two cultures obtained from Manila and kept on Musgrave and Clegg's medium, as *Entamœba coli.*

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BOTANICAL NOTES

Botany by the Experimental Method

A good many years ago some of us introduced to American colleges the laboratory method of learning about plants and this brought about a revolution in botanical teaching mostly for the better, but not wholly without some distinct losses. It is doubtful, for example, whether the pioneers in the laboratory method in this country ever contemplated the total abandonment of field work which followed in some places. It is pretty certain that they intended to *add* the laboratory method to the existing methods of study, which included the textbook, the field and the herbarium. Certain it is, however, that many teachers supposed that the adoption of the laboratory

method was to be followed by an abandonment of everything that had been done in the past. This was a serious error of judgment, and has led to no end of wasteful educational experiments. Because the laboratory method is good in one place is no proof that it is good in all. When I want to learn all that I possibly can of a new country I visit it if I can do so, and see all that I can of it, but I do not hesitate to use maps and read books pertaining to the country. I may even ask the people who have lived there longer than I to tell me all that they know. In this way I build up my knowledge of the country, and it is good and reliable, far more so, perhaps, than if I had relied wholly upon what I could have seen personally.

And so it is in botany. I must surely see as much for myself as possible, but life is quite too short for me to hope to see all that is known with my own eyes. Here and there, at critical and strategic points, I must see for myself and then I can go a long ways, when I must again get my reckoning by an observation. The mariner does not sail the seas by doing nothing but make mathematical observations. It would be slow sailing indeed were he to do so.

And yet this is just what some of the bookmakers are planning to have the children do. They are to learn everything about plants by the experimental method. They lose sight of the fact that there is no special saving grace in the labor of making experiments. We make experiments on plants in order that we may learn botany; we do not learn botany in order to make experiments on plants. Let every teacher remember that useless experiments involve as real a waste of time as dawdling or idling. I *can* walk from Lincoln to Denver, but it takes so much time that it will pay me far better to be carried there on a railway train.

All this is suggested by Mr. Payne's "Manual of Experimental Botany" (American Book Company), whose purpose, the author tells us, is "to teach botany by experiment." In two hundred and twenty-eight "experiments" and "exercises" the pupil is led over and into and among a great many facts pertaining to plants. Some of these exercises will prove to be interesting and helpful to pupils, but there are so many of them that it is quite impossible for the pupil to perform them with any care. It would have been far better to have selected a much smaller number, and to have placed them properly in a scheme outlining the subject. *That* would have introduced the pupil to the science of botany, *i. e.*, to an organized system of knowledge of plants. As it is, the child will have spent a great deal of time and energy in the making of experiments not definitely correlated, nor organized into a science. The pupil will have the results (more or less accurate) of a considerable number of experiments, but they will not constitute botany, that is, the science of botany, and it may be doubted whether in this unorganized form they will have any educative value. It would not be a bad thing to use this book as a store from which to draw such experiments as the teacher and pupil might wish to use in going systematically over the field of botany, although in some cases we must warn the teacher that the experiments will not "prove" all that they are supposed to demonstrate (*e. g.*, 130, 131, 132, 139, 145, 148, etc.). On the other hand, many of the experiments are well planned, and will prove interesting and instructive.

A HANDFUL OF LITTLE MANUALS

IT would seem that the solution of the problem of a handy manual for field work in systematic botany is to be reached by the compilation of little books covering restricted areas, or even confined to limited portions of the year.

Several years ago Professors Clements, Rosendahl and Butters brought out a little pamphlet of 40 pages entitled "Guide to the Spring Flowers of Minnesota," which has been well received by the schools of the state, and to this they have added a "Guide to the Trees and Shrubs of Minnesota," "Guide to the Ferns and Fern Allies of Minnesota" and "Guide to the Autumn Flowers." In the

same series we have also "Minnesota Mushrooms," by Professor Clements.

A year ago A. O. Garrett, of the Salt Lake City High School, published a little book of 106 pages, entitled "Spring Flora of the Wasatch Region," and including "the eastern edge of the Great Basin as far south as Manti" (central Utah). This is now followed with a second, considerably enlarged edition of 139 pages. It must be very useful to pupils in the schools of the region covered. It would be still more helpful if not confined to "spring plants" alone ("before June 15").

Much like the last is the "Spring Flora of the Intermountain States," by Professor Dr. Aven Nelson, of the University of Wyoming (Ginn), which in 202 pages covers Colorado, Wyoming, Montana, Idaho (excepting the northern part), a portion of eastern Oregon and the northern half of Utah. The treatment is much like that in the Wasatch Flora, and must be equally useful in the much larger region included. Here again one wishes that the "spring" limit could be removed.

Hall's "Yosemite Flora" (Elder, San Francisco) is a book designed to appeal in paper, pictures and binding more to the tourist than to the pupils in schools, and yet it must prove a most inspiring field manual for pupils fortunate enough to have access to its keys and descriptions. While called a Yosemite Flora, we are told that it is also "designed to be useful throughout the Sierra Nevada Mountains." Eleven most artistic plates and 170 text figures add much to the usefulness of the book for the beginner.

The "Flora of Nebraska," published by N. F. Petersen, instructor in botany in the Louisiana State University, is an attempt to name every plant (conifers and flowering plants) growing without cultivation in the state. It is modeled after Rydberg's well-known "Flora of Colorado," and like it the treatment is by the copious use of keys, by means of which the phyla, classes, orders, families, genera and finally the species are successively found. And after the species is determined by this method one finds a little paragraph assigned to it containing habitat, distribution and locality data. It will be useful to high-school pupils, in spite of the rather numerous typographical errors, due to the employment of a printer unaccustomed to scientific printing.

Here may be mentioned Professor Schaffner's "Key to the Families of Seed Plants" designed to aid his students (Ohio State University) to distinguish the natural plant families by carefully devised keys.

Botany in the Mountains

The University of Colorado Mountain Laboratory at Tolland, Colo., will hold its session this year, beginning June 24 and ending August 2, 1912. There will be a general course in field biology, in which both animals and plants are considered in relation to their environment, and also courses in systematic botany, ecology and biology of ponds and streams. Special attention will be given to research work.

The laboratory is situated in an interesting region at an altitude of nearly 9,000 feet. Tolland is the station for Boulder Park, a mountain valley surrounded by timber-clad hills. Within easy reach of the laboratory are typical pine and spruce forests, mountain meadows, narrow canyons, glacial lakes and alpine tundra. In addition to regular daily field trips which take the student to these various habitats of animals and plants there will be all day excursions by rail to the foothills and even to the plains for the purpose of making comparative studies of the flora and fauna of these localities. Professor Francis Ramaley, of the University of Colorado (Boulder), is the director of the laboratory.

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Special Articles

Nitrates in Soils[1]

The fertilizing value of materials that we now know to contain nitrogen was of course

[1] Paper read by invitation before the Society of American Bacteriologists at Washington, December, 1911.

recognized very early, though nitrogen was first recognized as a distinct element in 1772 by Rutherford.

Later it was demonstrated that nitrogen is an element indispensable to life, present in all organisms and the mass of literature, scientific, popular and commercial, concerning nitrogen in its various forms and their relation to plant growth is overwhelming to the student.

Yet, notwithstanding the long period of time during which we have recognized the importance of nitrogen, the aggregate of many life times that have been devoted to its study or the thousands of pages that have been published concerning its relation to plants, there still remain some of the most fundamental questions for solution.

The universality of nitrogen in plants is well authenticated. The amounts removed from the soil by a few leading crops are as follows:

Corn (45 bushels per acre)	63 lbs.
Cabbage (15 tons per acre)	100 lbs.
Clover hay (2 tons per acre) ..	82 lbs.
Wheat (15 bushels per acre) ...	31 lbs., etc.

Not only is it present, but it is indispensable, as has been repeatedly shown by careful water- or sand-culture experiments. Just how and why nitrogen is essential is a much more difficult question. It is a necessary element in the composition of protoplasm, and many other organic substances. It aids in the assimilation of other needed elements, and in photosynthesis. These functions of nitrogen would account for the need of a certain amount of available nitrogen in soils used for crop production. But it is found that soils with apparently an abundance of available nitrogen for the supply of many crops are benefited by the addition of still more nitrogen. Various theories which we will not enter upon here further than to point out that nitrogen or its compounds may serve other uses than by being merely absorbed or absorbed and assimilated have been proposed to explain this peculiar fact. What these other uses are is one of the large questions, as yet barely disclosed. Whatever other uses nitrogen may serve, that of a food element is unquestionably a preeminent one, and it is with this phase of the nitrogen subject alone that I shall deal.

Admitting the importance of nitrogen in assimilation the next question is: "In what forms is nitrogen available to the plant?" This, as has been the fate of many questions in biology, received its emphatic answer years ago, an answer that asserts itself convincingly through thousands of popular and scientific articles and text-books, but one which seems to be founded on very insecure evidence and one which is likely to be largely modified as research progresses.

The popular, almost the universal conception of available nitrogen is expressed in some such words as these, which are taken from prominent texts by famous authors and mostly from recent works.

> The majority of farm crops can use only that part of the nitrogen in the soil that is present as nitrate[1]

and on a later page:

> The plant can make use of the nitrogen only in the form of nitrates.
>
> The nitrates are the chief source of the nitrogen supply of green plants.[2]
>
> Sulphate of ammonia . . . must be nitrified before the nitrogen is available to plants.[3]
>
> The conversion of the ammonia formed during the process of putrefaction into the nitrates is a matter of greatest importance in soil fertility. . . . A soil to encourage nitrification must, then, have suitable basis. The question of soil fertility is, then, in its last analysis a bacteriological problem.[4]

This conception of nitrates has inevitably focused attention on nitrates as a soil factor of preeminent, of indispensable importance. It makes them appear so valuable that their coming and going are of superlative import and their failure to attend to spell disaster.

The subject assigned to me is "Nitrates in

[1] Vivian, 1909.

[2] Bergen and Davis, "Principles of Botany," pp. 233.

[3] Percival's "Agricultural Bacteriology," p. 142.

[4] Frost and MacCampbell, "General Bacteriology," 1910, p. 288.

Soils." I shall consider this subject under several heads as follows, setting aside purely physical and chemical phenomena and limiting myself to the biologic aspects of the question.

The origin of nitrates in soil nitrification and nitratation.

The destruction of nitrates in soil denitrification.

Methods.

The actual importance of nitrates.

Nitrification consists in the conversion of ammoniacal nitrogen into nitrites then nitrates, processes shown by the classic work of Winogradsky to be dependent on two separate groups of bacteria, the nitrite and the nitrate bacteria. Winogradsky's work has been abundantly confirmed and is not to be questioned. And so far as we know yet all nitrification results from this dual activity, the several reports that have been made of direct nitratation of organic nitrogen or of ammonia by bacteria lacking proper confirmation.

Ammonia is thus essential to nitrate formation and ammonification of organic nitrogenous substances is an essential preliminary step. Ammonifying bacteria are of numerous species, indeed some years ago in my laboratory a long search for soil bacteria that could not ammonify ended in failure. Ammonification in the light of present knowledge appears to be an absolutely essential process in the circulation of nitrogen, but the need is amply met and in no soil that I know of, and we have ourselves examined many hundreds, is there any actual deficiency in ammonifying power.

Recently the Rothamsted Station has attributed low yields to low ammonifying power due to consumption of ammonifying bacteria by predatory protozoa. This condition may exist in exceptional cases, but that it is in any wise general is not probable.

Nitrifying organisms have generally also been assumed to be present practically everywhere and in ample numbers. The results of a Bacterial Soil Survey conducted in my own laboratories and about to be published show that this assumption is not warranted. In a large per cent. of the soils tested the N.E. was very low. It appears, therefore, that while a deficiency in ammonification is not to be feared there may be instances, perhaps many of them, where the amount of nitrification falls below that of the nitrogen equivalent of a good crop. Why nitrification is vigorous in some soils and very poor in others is not known. In some instances it may be referred to unfavorable acidity, moisture, etc. Many cases are due to causes as yet unknown. That abundance of organic matter does not inhibit nitrification was clearly demonstrated in our own experiments, in which vigorous nitrification occurred in pure cow manure.

On the other hand, an exceptional case of injury from too great nitrification has recently been reported by Sackett.

Dentrification is the destruction of nitrates. It is brought about by many species of bacteria and may result in reduction of nitrates, to ammonia, various oxides or even to free nitrogen. This is unquestionably a detrimental process if it proceeds below the ammonia stage. The conditions necessary to denitrification are usually stated to be the proper organisms, moisture and organic matter. The organism is conceded to be commonly, almost universally present. Yet the fertilizer formulæ of the chemist and agricultural teacher usually call for an admixture of nitrates with dried blood, cottonseed meal, etc., thus surely furnishing ideal conditions for denitrification. Theory here opposes practise and as yet no decisive experiments have shown which is correct.

Methods.—I can not refrain in passing from referring to the absolute necessity in soil bacteriological work of making the tests in soils and not in solutions. Winogradsky found that in solutions organic matter inhibited nitrification. From this he and others have generalized that it does so in soil, a conclusion that is far from the truth, as our experiments have conclusively shown.

THE ACTUAL IMPORTANCE OF NITRATES

In all of the foregoing discussion we have assumed that nitrates are the necessary or at

least by far the most readily utilized form of nitrogen. The vast amount of research carried on in many laboratories regarding the processes of nitrification and dentrification indicate that these phenomena are regarded as of high significance and nitrogen of superlative value. Is this so?

Nitrogenous organic matter may be classified as proteids, albuminoids, amides and alkaloids. The larger part of the organic nitrogen in soils probably consists of acid-amines and amino and amino-acids.

To what extent may these or their degeneration products, particularly ammonia, serve as plant food?

A few years ago most special students and perhaps all general writers would have said that these substances must undergo nitrification before they are available to plants. Today, without much evidence, perhaps without any evidence that will stand searching criticism, there is a tendency among some writers to hedge on this point and to speak of ammonia as well as nitrates as possessing available nitrogen. We even hear the term "active nitrogen" embracing ammonia and nitrate nitrogen.

The evidence on this question is too voluminous to bring before you, but we may summarize it something as follows:

Innumerable experiments have been made bearing upon the relative availability of nitrate and ammonia nitrogen to plants. Most numerous of such have, of course, been field tests of ammoniacal compounds and of nitrates drawing conclusions from the yield or the crop analyzed. Such tests are manifestly inconclusive, since in all cases the question of nitrification in the soil is an ignored factor and it is not in reality known whether the ammonia that is applied to the soils is used as such or is first nitrified or indeed whether the reverse may not be true, viz., that the nitrates have been reduced to ammonia and utilized in that form. The general conclusion that can be drawn from such experiments is that ammonia applied to soils does not, with most crops, on most soils, give so large crop returns as do nitrates. The common ratio of utility is generally given as something like 60 or 70 to 100. This conclusion varies, however, for different crops, different soils, different times; and such experiments are far from giving a solution of the fundamental question.

Another line of attack is by means of water-culture experiments. Many such lack bacteriological control and the conditions regarding nitrification are not known. A few have been conducted with rigid bacteriological control and do actually prove that a plant can assimilate ammonia without its previous nitrification. Such tests, however, do not simulate field conditions much more closely than would experiments on the habits of squirrels parallel nature if conducted in aquaria. Our results of comparative tests of the functions of bacteria in soils and in solutions have given us entire lack of faith in such abnormally conditioned experiments.

Again, plants have been grown in sterile soils under aseptic conditions, with constant and rigid chemical and bacteriological control. Such results may properly pose as qualitative. But they are not quantitative, because of necessity they are conducted on but a few plants and the factor of individual variation is so great that quantitative results are vitiated unless a sufficiently large number of plants be used to reduce the coefficient of error to something like a negligible quantity. Also the conditions of control involving abnormal radiation, ventilation, etc., are unsatisfactory.

Jost says:[8]

> Many hundred culture experiments in water and sand have established the fact that nitric acid forms an excellent, not to say the best possible source of nitrogen for the great majority of plants. (How the divergent results arrived at by Treboux (1905) are to be explained it is, as yet, impossible to say.)
>
> The recent comprehensive researches of Pitsch (1887–1896) and of Mazé (1900) have conclusively proved that the nutritive value of ammonia must not be entirely denied; in the majority of green plants it is second only to nitric acid in value.

[8] Jost's "Plant Physiology," pp. 134 and 135.

In the case of some plants, particularly maize and other Gramineæ, ammonia is by no means of inferior value to nitric acid, for Mazé was able to obtain as great an increase in dry weight in maize, using at most a one half per cent. solution of ammonium sulphate, as when he supplied it with a solution of a nitrate. Similar results were obtained in cultures of *Brassica* and species of *Allium*. Forest trees also must be dependent on ammonia, since nitrates are seldom present in woodland soils.

So far as we know at present it is quite certain that in addition to plants which definitely prefer nitric acid (*e. g.*, buckwheat, potatoes, turnips) there are others which get on just as well or even better with ammonia.

Perhaps after all the most conclusive proof that plants in nature can do well without nitrates comes from the fact that certain peat soils have been shown to be devoid of nitrates, yet they amply support plant growth. Again, rice responds well to ammonia even in soils where no nitrification can be detected.

Also it is true that we, as well as other investigators, have shown that soils very low in nitrification may be very productive and that on such soils plants respond readily to organic matter or ammonia, indicating that nitrification is often not an essential factor to soil fertility.

The general conclusion regarding the availability of ammonia and nitrate-nitrogen is that both can be used by many plants; that often nitrate nitrogen applied in the field gives larger crop yields. But the relative availability of these nitrogenous substances for crop plants under natural conditions has not yet been determined. This is an essential desideratum. A question that must be answered conclusively before we can know the significance of nitrification and dentrification.

It seems after all that ammonification is the essential thing and that nitrification is relatively unimportant, but this is only indicated, not proved.

There is need of rigid proof as to the relative availability to each crop plant of ammonia and of nitrate nitrogen. Then we shall know the true importance of the problems of nitrification and of denitrification. Following this knowledge will come the questions of correcting such evils as need correction, the heightening of nitrifying power in cases where this is low and where higher nitrification would be of advantage; the lowering of denitratation if this be a disadvantage and where it is a disadvantage.

Plant physiology must join hands with soil bacteriology to ascertain which are the significant problems that conditions of deficiency may receive correction.

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Reactions of Young Lobsters Determined by Food Stimuli

In recently glancing through some old notes written several years ago, when the writer was interested in problems relating to the behavior of the larval lobster (*Homarus americanus*), certain unpublished data regarding the reactions to food-stimuli came to light. It is the aim of the present note to give some of these data, which may be regarded as supplementary to the material published in 1908,[1] terminating the writer's investigations on the subject of behavior of *Homarus*.

Many students of animal behavior have learned that the condition of hunger is able to greatly modify the reactions of organisms to many stimuli—especially to food. Generally speaking, it has been found that hunger prevents the manifestation of certain normal types of reaction. The effect of hunger upon certain stages of *Homarus* is no exception to this rule. In this instance, however, the condition of hunger has been thus far found instrumental in modifying the reactions of the lobster only in the fourth and later stages, for similar experiments upon lobsters in the earlier stages have not yet been made. One reason for this is the fact that the larval lobsters of the first three stages are not able to direct their own activity in a definite direc-

[1] "The Behavior of the Larval and Early Adolescent Stages of the American Lobster (*Homarus americanus*)," *Journ. Comp. Neurol. and Psychol.*, 1908, 18, (3), 199–301.

tion, as toward food; and it is not until the fourth stage is reached that the lobster can be truly said to be master of its own movement. It was learned in the early stage of the investigations on the behavior of the fourth-stage lobsters that, if any study at all was to be made of their reactions to light, the lobsters must first be fed—and well fed. For, if such was not the case, the tendency to eat one another usually annihilated any possible manifestation of a response to the influence of light or other stimuli. Even if the condition of hunger did not excite these extreme cannibalistic instincts, and so preclude all experimentation, it produced a manifestation of unrest which made any results in the way of numerical counts impossible. As has been shown in earlier papers, the fourth stage-period, at least in the early part, is typically a "swimming-period"—the "swimming-period" *par excellence* of the lobster's whole existence. It is not until the latter part of the fourth stage-period that the lobster, under the proper conditions of environment, goes to the bottom and begins to burrow in the sand or under the bits of shell. Now it was found that the condition of hunger appeared to have a very definite influence upon the time at which this burrowing "instinct" was first "liberated" in the fourth-stage lobster. To determine this point, several experiments were performed of which the following is a fair example of all.

Experiment A

Influence of Hunger on "Burrowing."—On August 5 about thirty early four-stage lobsters were taken from one of the confinement bags, in which they were being reared. They did not show much evidence of hunger and were therefore isolated for 48 hours without food. At the expiration of this time, all proved to be very hungry. Now two groups of five lobsters each were taken from this lot, and each group was placed in a 14 cm. crystallization dish, the bottom of which was covered with sand, gravel and shells. Immediately after this, one group of lobsters was fed with chopped clam meat; the other group was left hungry. The dishes were then placed on the laboratory table, and records were taken frequently to ascertain at what time the burrowing would be first manifested; and in which group of lobsters—the fed or the unfed. For some little time the members of both groups swam more or less constantly at or near the surface. Further records, which show the time of burrowing of the individuals in the two groups, may be presented as follows:

Time	Group Fed	Group Unfed
Aug. 7, 10:00 A.M.	1 larva burrowed.	5 larvæ swimming or crawling.
Aug. 7, 11:30 A.M.	2 larvæ burrowed.	5 larvæ swimming or crawling.
Aug. 7, 3:30 P.M.	3 larvæ burrowed.	5 larvæ swimming or crawling.
Aug. 8, 9:00 A.M.	4 larvæ burrowed.	5 larvæ swimming or crawling.
Aug. 9, 9:00 A.M.	4 larvæ burrowed.	3 larvæ burrowed.[2]
Aug. 9, 6:00 P.M.	4 larvæ burrowed.	4 larvæ burrowed.

These results appear to show that hunger may postpone the liberation of the burrowing instinct, while satiety appears to favor its early appearance. One other experiment, and the converse of the previous case, may be introduced.

Experiment B

Influence of Food-stimulus upon Surface-swimming in the Fourth-stage Lobsters.—In this case about twenty mid and late fourth-stage lobsters were placed in a glass jar 25 cm. in diameter filled with salt water to a depth of 10 cm. These lobsters were kept without food until they showed evident signs of hunger. All the lobsters remained on the clean bottom of the jar, over which they crawled or lightly swam. Occasionally one would come to the surface, only to leave it again for the bottom of the jar. Now a long pipette was partly filled with fresh clam juice, and the outside of the pipette carefully washed to take away all possible trace of clam odor

[2] At this point in the experiment one of the five lobsters was killed and eaten by the others, three of which immediately burrowed.

from the surface of the tube. When the lobsters were found to be resting quietly on the bottom of the dish, the point of the pipette was slowly lowered to the very bottom of the jar, where a few drops of clam juice were liberated in the vicinity of the fourth-stage lobsters. Within a few seconds all the lobsters in that region rose immediately to the surface of the water and swam wildly about for a variable length of time, after which they again went to the bottom of the jar. Here they either rested permanently or, if a sufficient amount of the clam juice remained near the bottom of the jar, apparently restimulated, the lobsters manifested further surface-swimming. These same tests were tried on the fifth-stage lobsters, but, although the clam juice might excite them to more active crawling over the bottom of the jar, it never produced surface-swimming, as in the case of the fourth-stage lobsters. These observations have received further support from the facts which the writer once learned from Dr. V. E. Emmel. It appeared in his case that the hungry lobsters with which he chanced to be working, when stimulated by a piece of clam meat dropped into their confinement bottles, would not remain on the bottom to enjoy the morsel, but would rise to the surface and manifest active swimming for some moments. These few observations demonstrate clearly that the lobsters, at least of a certain age, respond very definitely to certain kinds of food-stimuli. To what extent this kind of reaction may be responsible for the surface-swimming so characteristic of the early fourth-stage lobsters under natural conditions it is difficult to say. It is not improbable, however, that, after the fast which usually accompanies the approach of the third moulting-period the great hunger which characterizes the early fourth-stage lobster may be, in part, at least, the cause of the surface-swimming, although, as has been shown in previous publications, the reaction to light is also no doubt an influential factor.

Philip B. Hadley

Kingston, R. I.,
January 22, 1912

SOCIETIES AND ACADEMIES

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

The 458th regular meeting of the society was held in the new National Museum at 4:45 P.M. on February 6. Professor Mitchell Carrell presented a paper entitled "The Excavations at Knossos or Labyrinth of Minos," illustrating his talk with the lantern.

On February 20 the retiring president, Dr. J. W. Fewkes, made an address on "Great Stone Monuments in History and Geography," at eight o'clock in the new National Museum. Dr. Fewkes's paper will appear in full in the Smithsonian Miscellaneous Collections.

The 459th regular meeting of the society was held in the new National Museum at 4:45 P.M. on March 12. Miss Densmore read a paper on the "Sun Dance of the Teton Sioux." This paper was based upon a study of the sun dance made among the Teton Sioux on the Standing Rock reservation in North Dakota and represents the sun dance usage in that band of the tribe. The study was conducted in a series of councils to which the old leaders of the tribe came from a radius of about a hundred miles. Fifteen reliable men were selected to give the account of the sun dance, their authority being established by interviews with about forty members of the tribe, in widely separated localities. Those who took part in the sun dance councils were men who bore upon their bodies the scars of their participation in the sun-dance tortures, and among them were the man who acted as intercessor in the ceremeny and the man who "did" the cutting of those who fulfilled vows, both men being the only Tetons living who had performed these official acts. The men comprising the sun-dance council, with the writer and an interpreter, visited the site of the last sun dance held by the Teton Sioux in 1882, the site being identified by the Indians. The place where the sun-dance pole was erected, the outline of the "shade-house" and the location of the "sacred place" were recognized and measurement showed them to be correct, according to the usual plot of the sun-dance grounds.

The sun dance was held annually by the Sioux and was distinctly a religious ceremony. The fulfilling of vows of torture was an important part of the ceremony, the vows having been made by men in danger on the warpath. When making the vow they asked

for a safe return and that they might find the members of their family alive and well, and the fulfillment of the vow was required whether the prayer was granted or denied.

The paper was illustrated by songs of the sun dance which had been recorded by the phonograph and were played on the piano. Many of these were ceremonial songs and known only to the man who sang them for the speaker. One of these men has died since the songs were recorded. A collection of old ceremonial articles used in the sun dance was also exhibited.

THE 460th regular meeting of the society was held April 10 at 4:45 P.M. in the new National Museum. The speaker of the afternoon was Professor Pittier, who delivered an address on "Notes on the Native Tribes of Panama," with all of whom he came in contact in the course of his travels.

There is much confusion current as to the number of the so-called tribes and the stocks to which they are related. The numerous names recorded correspond in fact not to distinct tribes, but merely to villages, names of chieftains, or, in a general way, to what the old Spanish chroniclers used to design as "parcialidades."

In the present time there are east of the Canal Zone only two distinct "nations," viz., the Cunas, or Cuna-Cuna, to which the San Blas Indians belong, and the Chocoes to the south, beyond the Tuyra River. The line that separates these two stocks is at the same time the ethnological boundary between South and Central America.

The Cunas are a very numerous and strong race, almost uniformly of short stature and broad shoulders. They are very jealous of their independence and shun all interference on the part of strangers, including the Panamanian government, the authority of which over them is only nominal. The Cunas of the northern coast, east of Nombre de Dios, or San Blas Indians, are far above the other Panamanian aborigines in their social and economic development; they constitute one of the best elements of the population included in the territory of the young republic, being thrifty and enterprising and having made of their extensive cocoanut palm plantations a real source of wealth. The remaining Cunas, known as Bayanos, Chucunacas and Payas, live in the interior and are less advanced, the two former groups being acknowledged as real "Indios bravos." All speak one language, with slight local variations.

The Panamanian Chocoes are but the northernmost branch of a numerous stock which extends more or less continuously along the Pacific coast of South America, from Punta Grachine in Darien, to the Ecuadorian boundary. In the Sambú Valley, where Professor Pittier found them, they are a happy lot, usually tall and well built, scantily clothed and living quite near to nature.

West of the Canal Zone, in the mountains of Veraguas and eastern Chiriqui, live the polygamous Guaymies, once under the care of the Spanish missionaries, but who have long since gone back to their own independent life and customs. They do not, however, avoid or repel the contact with the other natives, and owing to the rapid expansion of the neighboring populations, so-called civilized, the Guaymies are doomed to soon lose their characteristics and individuality as a race. Certain ethnological traits, as well as their physical appearance, point to a relationship with Costa Rican tribes.

In consequence of what Professor Pittier calls a "caprice of arbitration," the Republic of Panama has acquired the northern branch of the Térrabas or Tirúb of Costa Rica. These dwell in small and rapidly dwindling numbers at the headwaters of the Teraria or Tilorio, the main branch of the Changuinola River. They have been investigated by Pittier in the course of his survey of Costa Rica.

These four are the tribes represented to-day in Panama. The Dorasques, supposed by some to descend from the great Chiriqui pottery makers, seem to have disappeared, unless the Brunka of Costa Rica are really what is left of them.

With reference to the possible affinities of the Panamanian tribes with the neighboring stocks, the speaker took absolute exception to the theory of the Chibchan relationship, which he was one of the first to advocate about twenty years ago and which has since received general acceptation under the authority of Brinton, Deniker and others. The pretended relationship is founded merely on linguistic analogies and on the apparently common origin of quite a number of words. But these facts can be taken as conclusive only if supported by anthropological common characteristics and also by partial community of uses and customs. Physically, the Cunas are strikingly distinct from the Guaymies and the Costa Rican Indians, and both stocks offer none but general racial likeness with what is left of the original Chibchas.

In the opinion of Professor Pittier the origin of the Cuna-Cuna has to be looked for elsewhere than in the interior of Colombia, and the Guaymies, Valientes, Bribri, Térrabas, Sumos, etc., are more likely to be the remnants of a primitive autochthonous stock. Pittier's talk was illustrated by numerous lantern slides and the exhibition of the objects collected among the Chocoes and Guaymies.

TRUMAN MICHELSON,
Secretary

THE BOTANICAL SOCIETY OF WASHINGTON

THE 81st regular meeting was held at the Cosmos Club, May 7, 1912, at 8:00 P.M. President W. A. Orton presided. Twenty members were present.

The following papers were read:

Further Studies on the Pecan "Rust": F. V. RAND.

A preliminary report on the fungus causing this pecan leaf disease was published in *Phytopathology* for August, 1911, under the name *Mycosphærella convexula.* Since that time the fungus in question has been obtained from a number of other sources and several strains known to have originated from single two-celled ascospores have been under study. In the course of one and one half year's growth in culture, strains originally producing a majority of apparently two-celled ascospores have gradually changed, until now most of the ascospores are distinctly non-septate. Furthermore, a typical *Glœosporium* form was developed in culture and also obtained from the host. A large number of colonies known to have originated from single ascospores or single conidia all gave cultures producing both perithecial and conidial forms, showing the two to be different phases in the life cycle of the same fungus. Inoculations on Jonathan and Yellow Newton apples gave a decay similar to bitter-rot, with production of conidia and immature perithecia on the latter. Inoculations on young pecan leaves under greenhouse conditions gave negative results, but infections together with production of conidia and mature perithecia, readily occurred on living leaves in a damp chamber. From the studies summarized above it would appear that the fungus is closely related to if not identical with *Glomerella rufomaculans,* and that it is not a very active parasite on the pecan.

Distribution of Pigment in the Seed-coat of the Cowpea: Dr. ALBERT MANN.

Transverse sections of the seed-coat disclose three principal layers of cells: an outer palisade layer, a heavy-walled layer below this of empty cells, and a layer of considerably compressed cells with long axis parallel to the surface of the cowpea.

It was found that the colorations in the cowpea are the result of pigments deposited in two of these layers. In all colored cowpeas there is a basal color or practically uniform tint and invariably to be found in the lowest of the three layers, which the speaker terms the basal color layer. This is a melanin compound of an orange-yellow tint, grading into lemon-yellow and pale buff. All other colors are obtained by superposing upon this basal color layer various pigments, and these are uniformly deposited in the palisade cells, and as a rule in the lower and larger third of the cell cavity. Three colors are found here: black to blue-black, or sometimes purple tint, which is an anthocyanin, a yellow or brassy-brown pigment and an intense black pigment, the last two being melanin compounds. By various arrangements of these three superposed tints in the palisade cells, or by the absence of any pigments in these cells, the various schemes of coloration in the cowpea are obtained; the marbling, blotching, dotting, as well as the uniform colors of some cowpeas, being produced by the basal color plus such superposed arrangements of color in the palisade cells as are characteristic of the different varieties.

In the case of the few cowpeas having white or colorless seed-coats, the result is obtained by the suppression of all pigments both in the basal color layer and in the palisade layer.

A wild cowpea secured from North Nigeria, Africa, is of particular interest, in that upon the same cowpea all the elements of color, as well as all the schemes of coloration are to be found.

The Purpling Chromogen of the Hawaiian Bitter Yam: H. H. BARTLETT.

Illustrations of the Phytogeography of the North American Continent: Dr. JOHN W. HARSHBERGER (by invitation).

The speaker displayed to the society an album of twelve volumes of photographs and illustrations of North American vegetation, collected during the preparation of his recently published work on the phytogeography of North America. The source of the material and method of preparation and classification were discussed, and the general plan and scope of the work were explained in detail.

W. W. STOCKBERGER,
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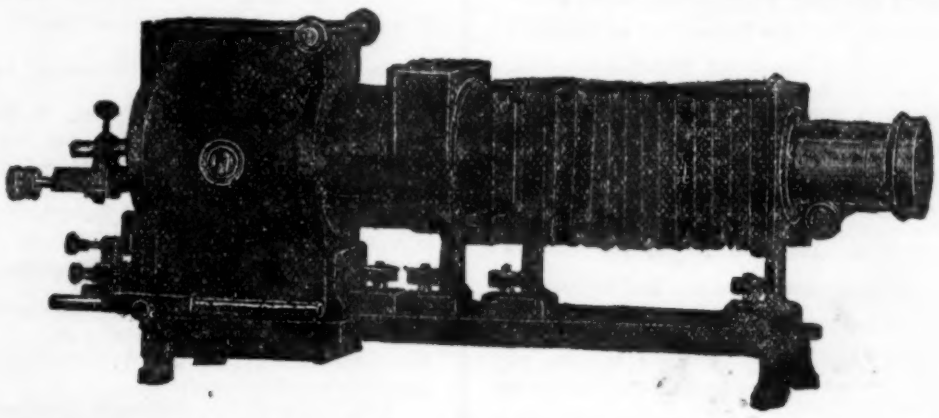

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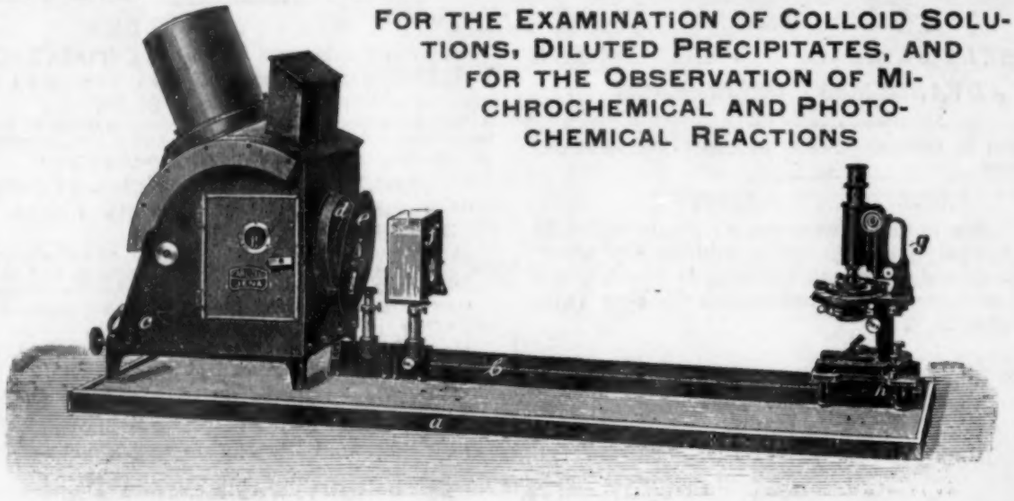

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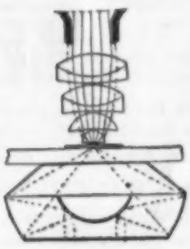

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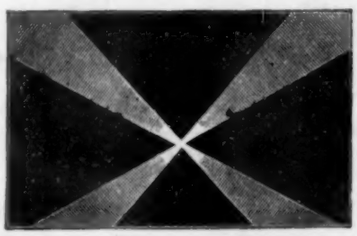

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